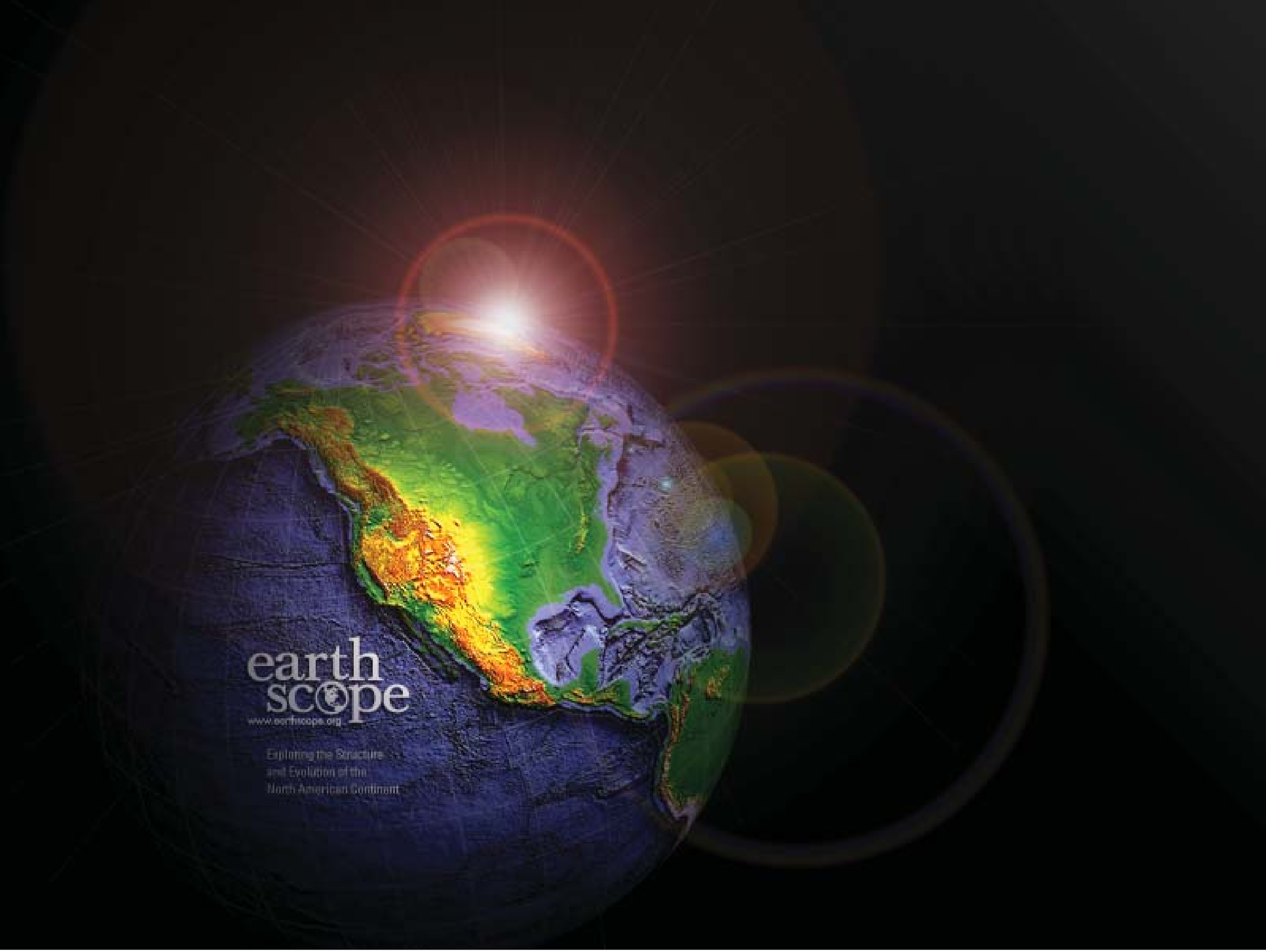

earth
scope
www.earthscope.org
Exploring the Structure
and Evolution of the
North American Continent

Acknowledgements

- **EarthScope** is funded by the National Science Foundation and conducted in partnership with the US Geological Survey.
- **EarthScope** was constructed, and is being operated, and maintained as a collaborative effort with UNAVCO, Inc., IRIS, and Stanford University, with contributions from NASA and several other national and international organizations.
- **UNAVCO** is a non-profit, membership governed consortium of Universities that facilitates geoscience research and education using Geodesy.
- **The Plate Boundary Observatory** is the geodetic component of EarthScope, installed and operated by UNAVCO and funded by the National Science Foundation.

EarthScope Scientific Mission

- Explore the structure and evolution of the North American Continent, and the physical properties that control earthquakes and volcanoes.

SAFOD

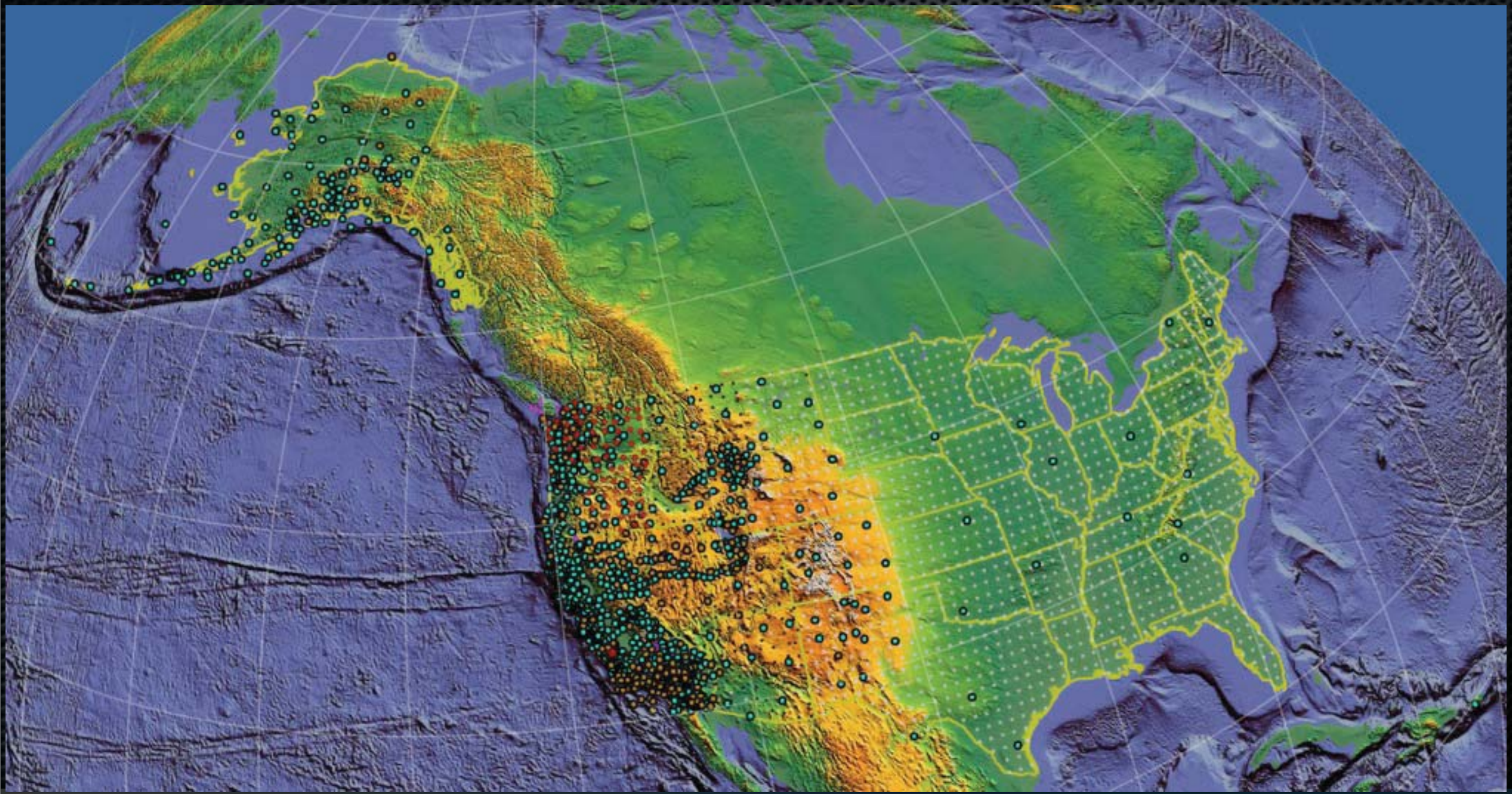
USArray

PBO

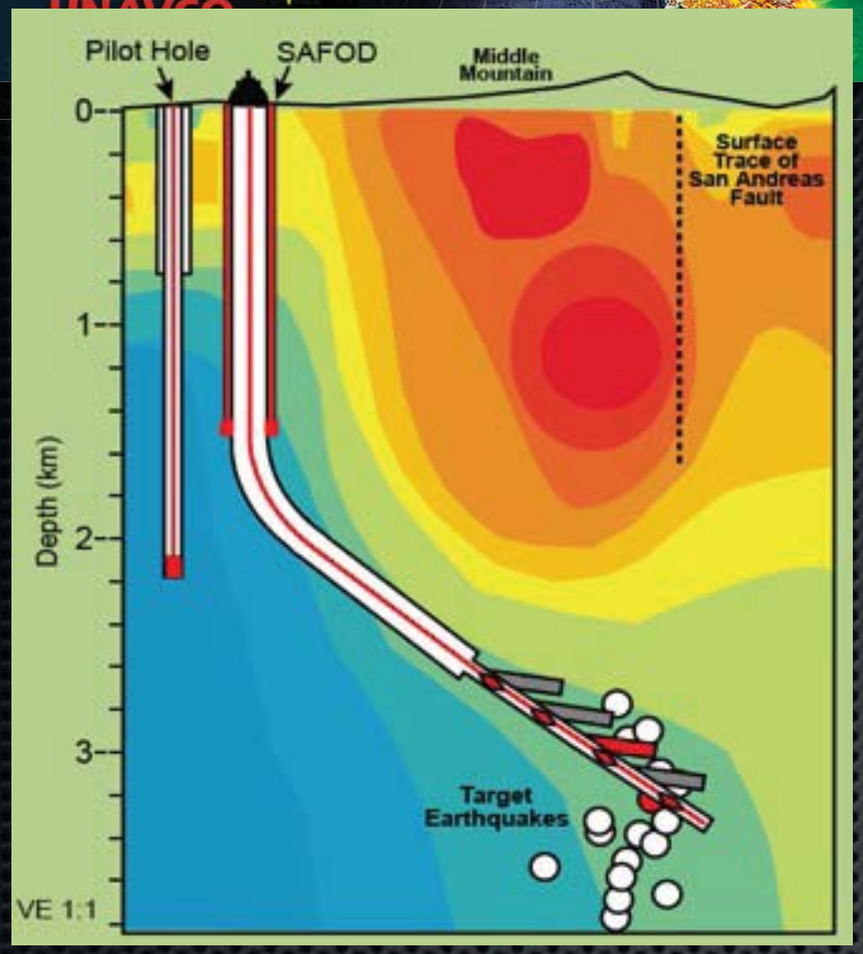
How do we achieve this?

- Instrumentation
- Integrated Research
- Education and Outreach
- Cyberinfrastructure

- Deep-borehole
- GPS Network
- Strainmeter networks
- Seismic networks



SAFOD



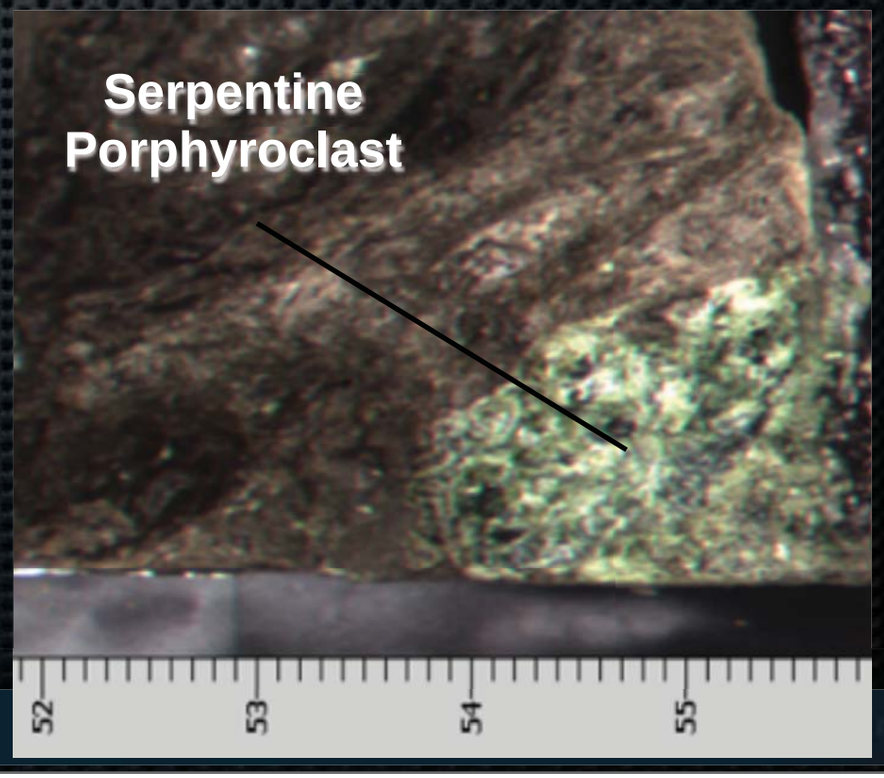
Fault Gouge Layer (1.5 m thick)

Highly sheared serpentinite layer with fragmented calcite veins

Foliated fault gouge with serpentinite and sandstone porphyroclasts

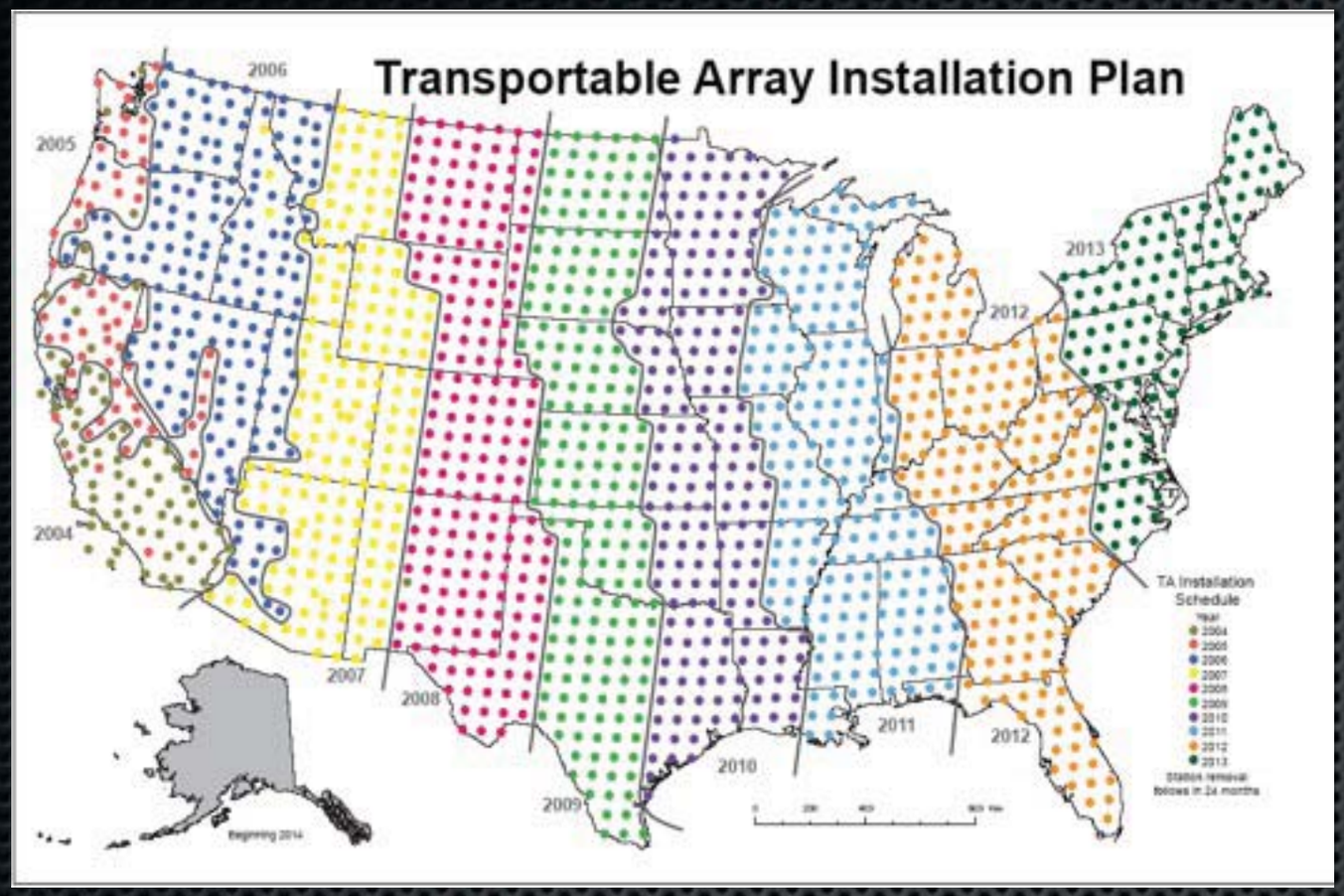
Foliated gouge with serpentinite and sandstone porphyroclasts

Serpentinite cut by white (calcite) veins



EarthScope USArray

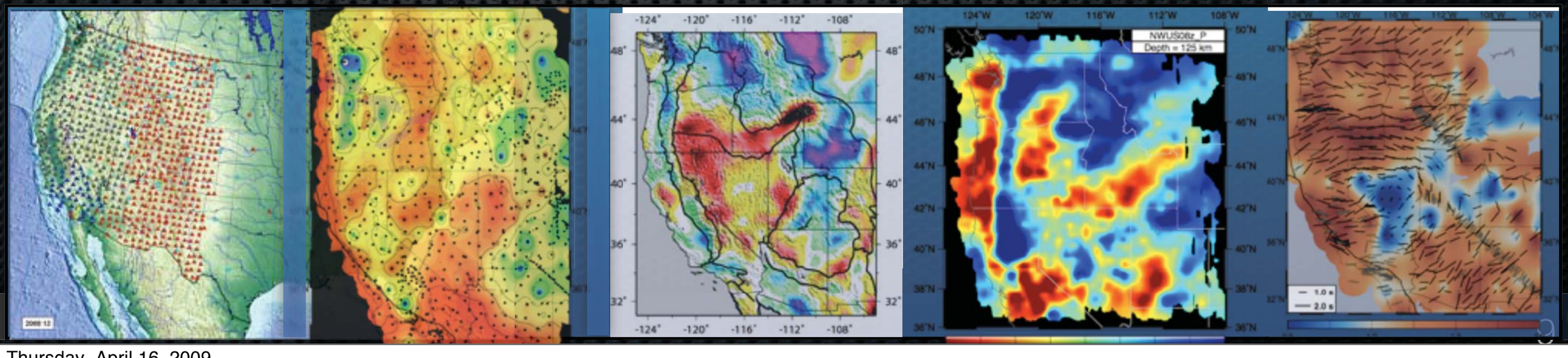
2004 → 2013



Seismic Transportable Locations

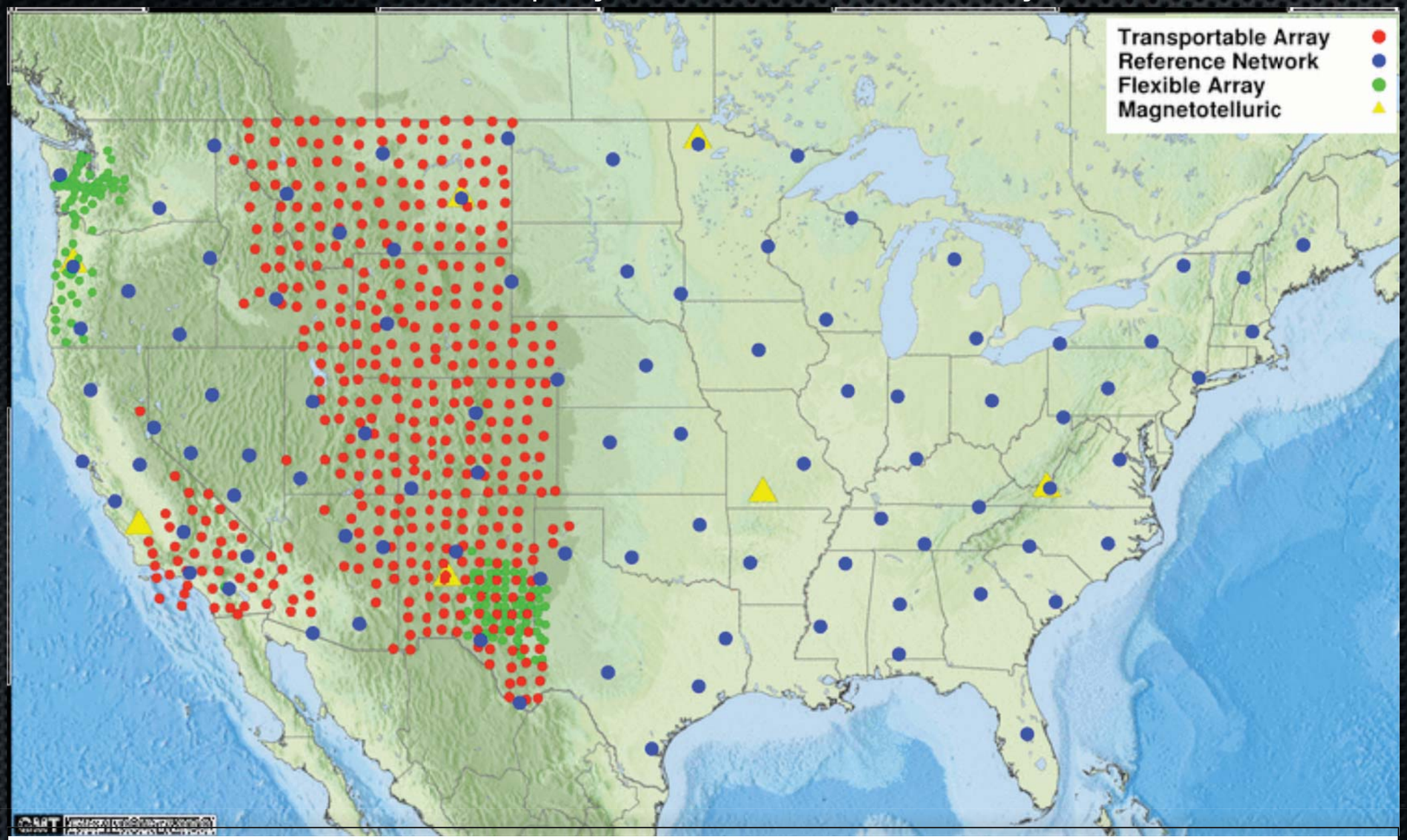
- **400 broadband seismic stations**
  - ~70 km spacing
  - ~1500 x 1500 km "footprint"
  - ~2 year deployments at each site, 1623 sites
- Roll across the country in 10 years

Transportable Array | Crustal Thickness | Surface Wave Speeds | Seismic Tomography | Mantle Flow



USArray at a Glance

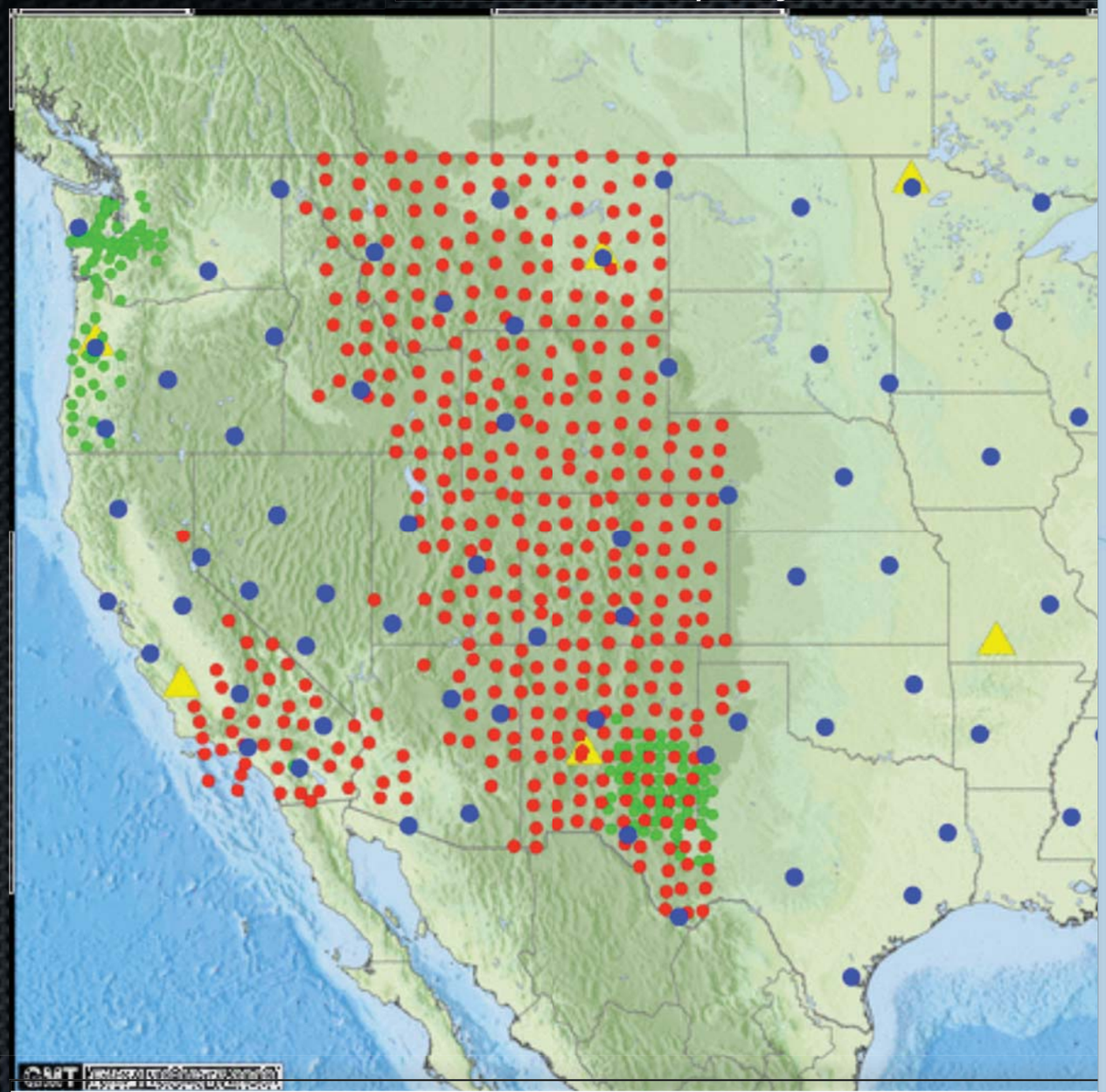
Stations deployments as of February 2009



Unique characteristic of USArray: A highly distributed observatory that was amenable to transitioning incrementally from construction to O&M

USArray at a Glance

Stations deployments as of F



Adopted Stations and Vaults

Unique characteristic of USArray

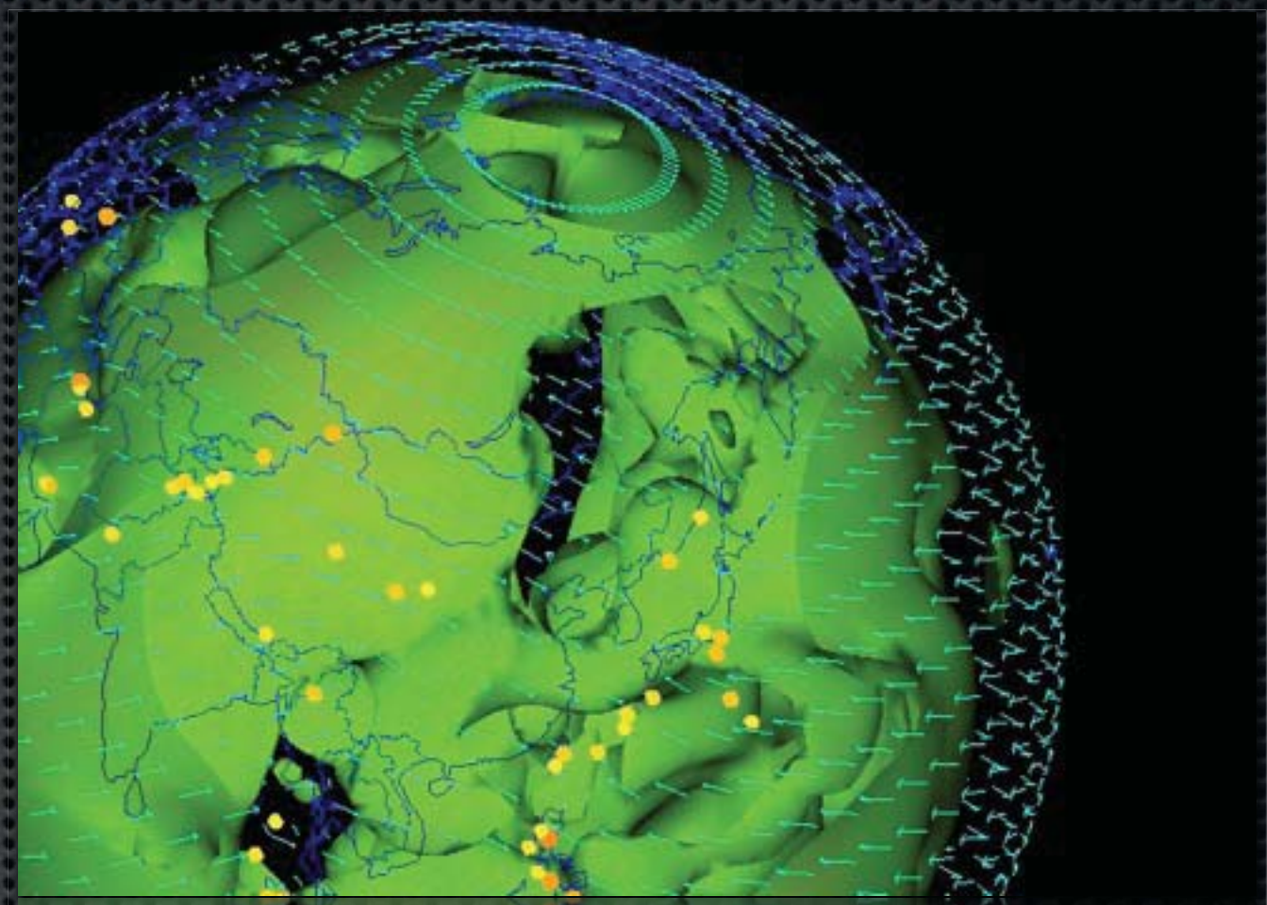
observatory that was amenable to tra

from construction

The TA is leaving a “wake” of permanent stations

PBO Science Goals

- What are the forces and processes driving deformation at plate boundaries and in plate interiors?
- What is the rheological structure of the lithosphere and where is its strength?
- What drives strain release on active faults (e.g. earthquake and/or aseismic slip events)?
- Is there long-term transient deformation within the plate boundary zone, and if so, what are the characteristic temporal scales and underlying causes?



- How is magma transported within the crust and to the surface?
- How can we reduce the hazards of earthquakes and volcanic eruptions?

earth scope
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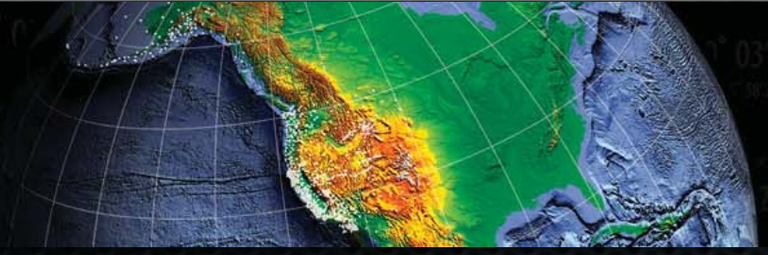


What is the Plate Boundary Observatory?

Focused, dense deployments of GPS and strainmeters

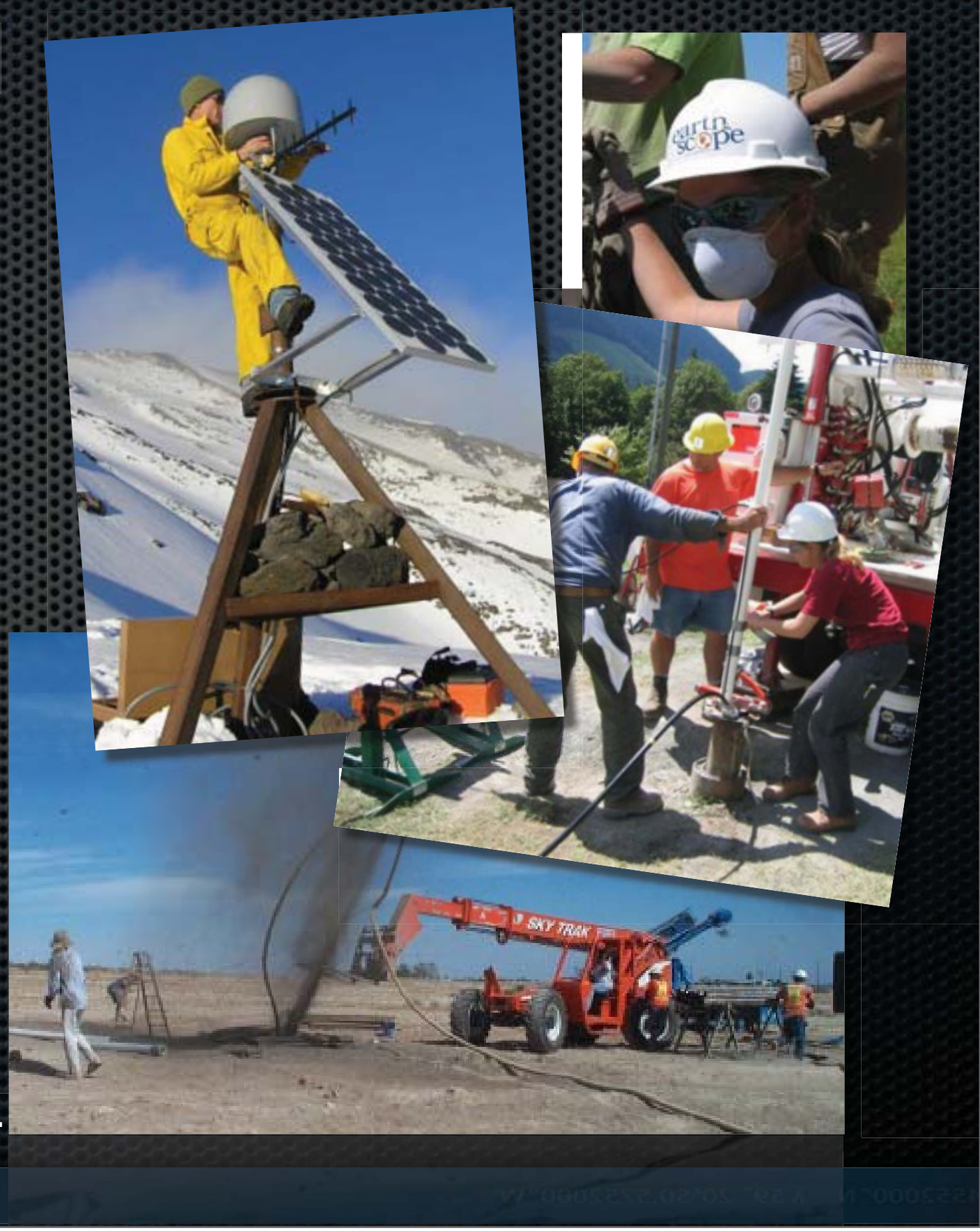
- 1100 continuous Global Positioning Systems around tectonic clusters.
- 74 borehole strainmeters.
- 78 borehole seismometers
- 6 long baseline strainmeters.
- 26 Tiltmeters

Portable GPS receivers

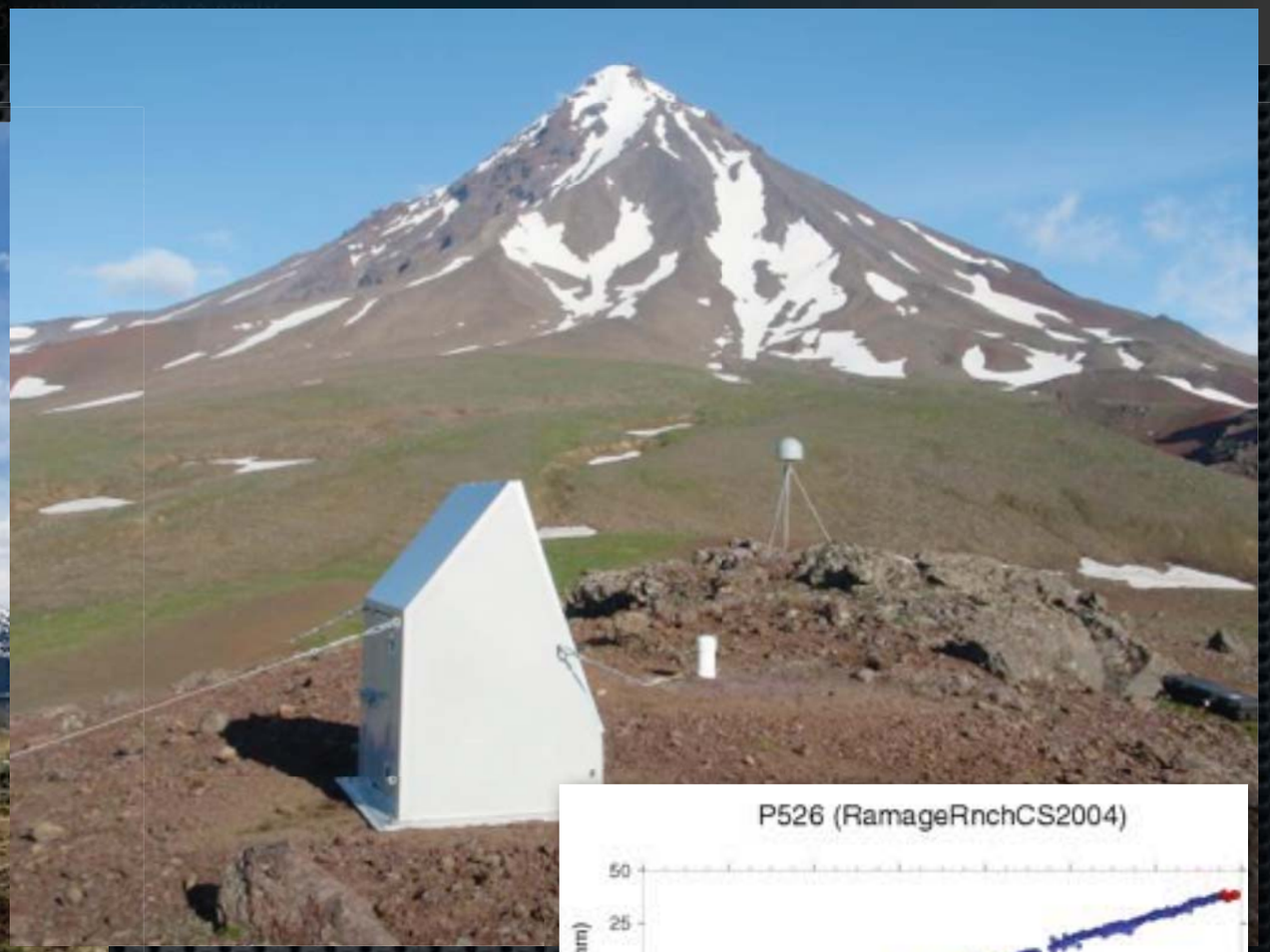
- Pool of 100 portable GPS receivers for temporary deployments to areas not sufficiently covered by continuous GPS.

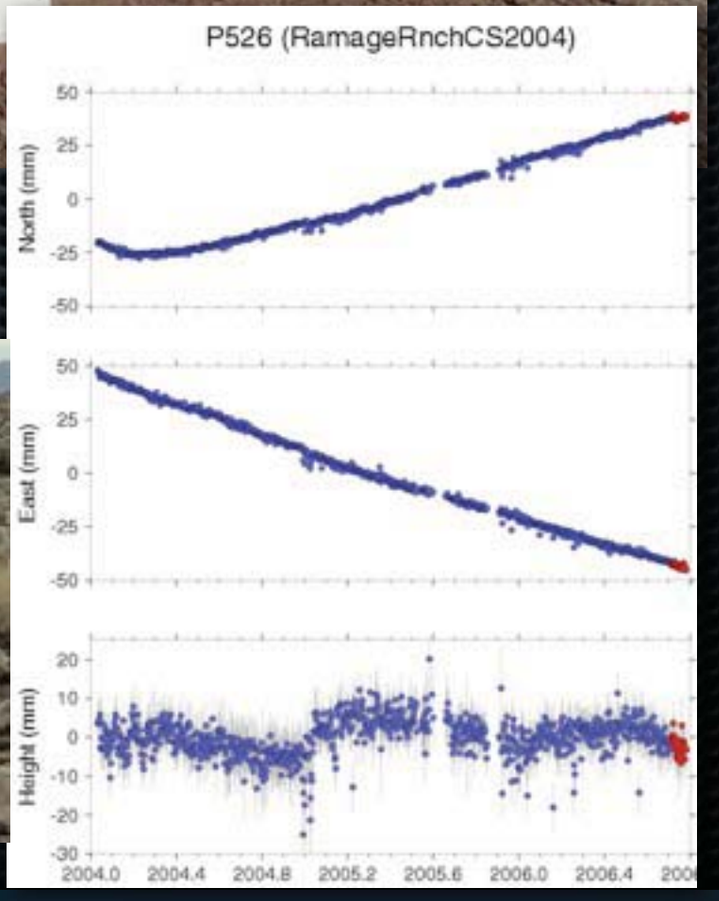
Geo-EarthScope

- InSAR imagery covering the western US.
- LIDAR imagery covering the northern and southern San Andreas Fault, Yellowstone Caldera, and faults in Cascadia and Alaska.

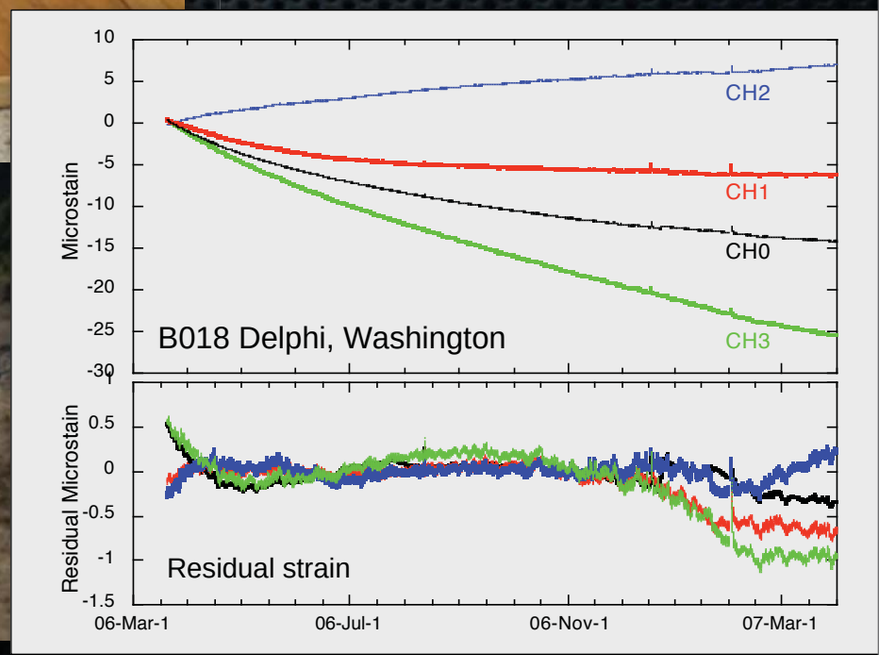


GPS Stations





BSM Stations

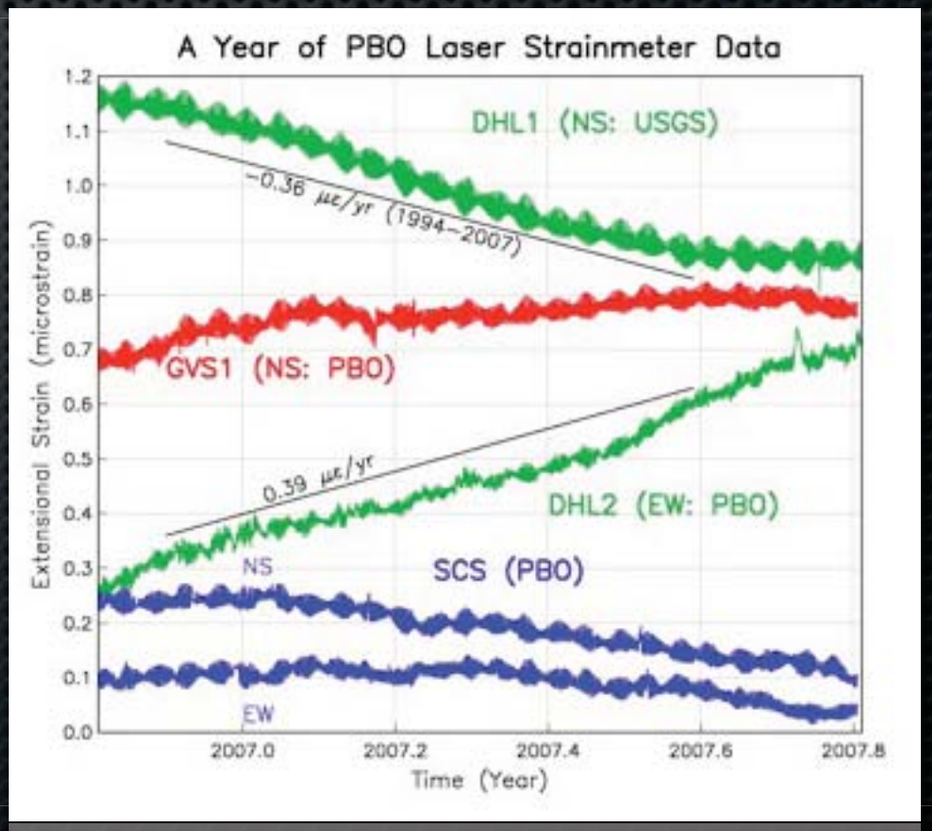


LSM Stations

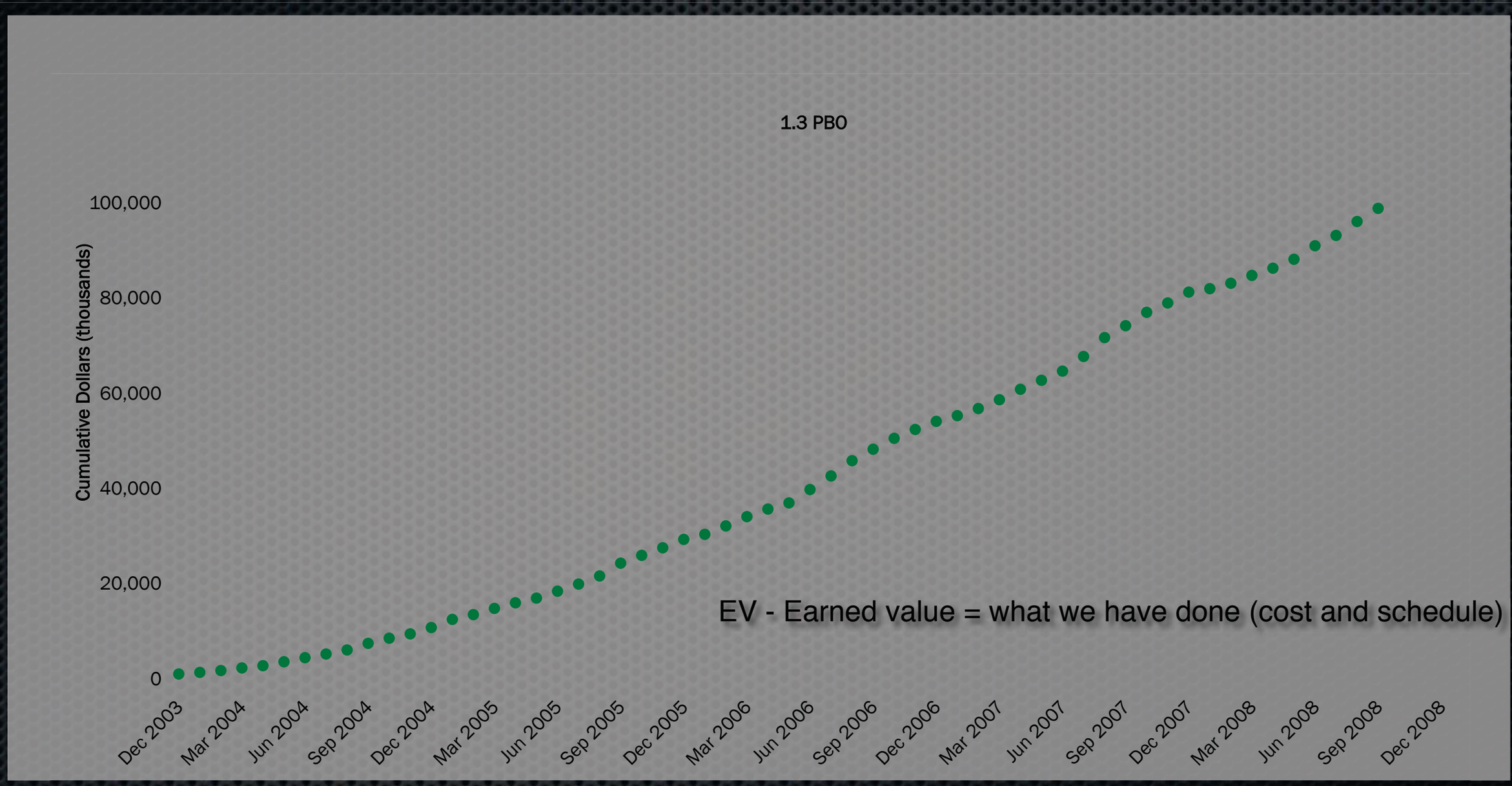

Salton Trough


Verdugo Canyon


Cholame



PBO MREFC Completion



PBO MREFC Completion

earth scope
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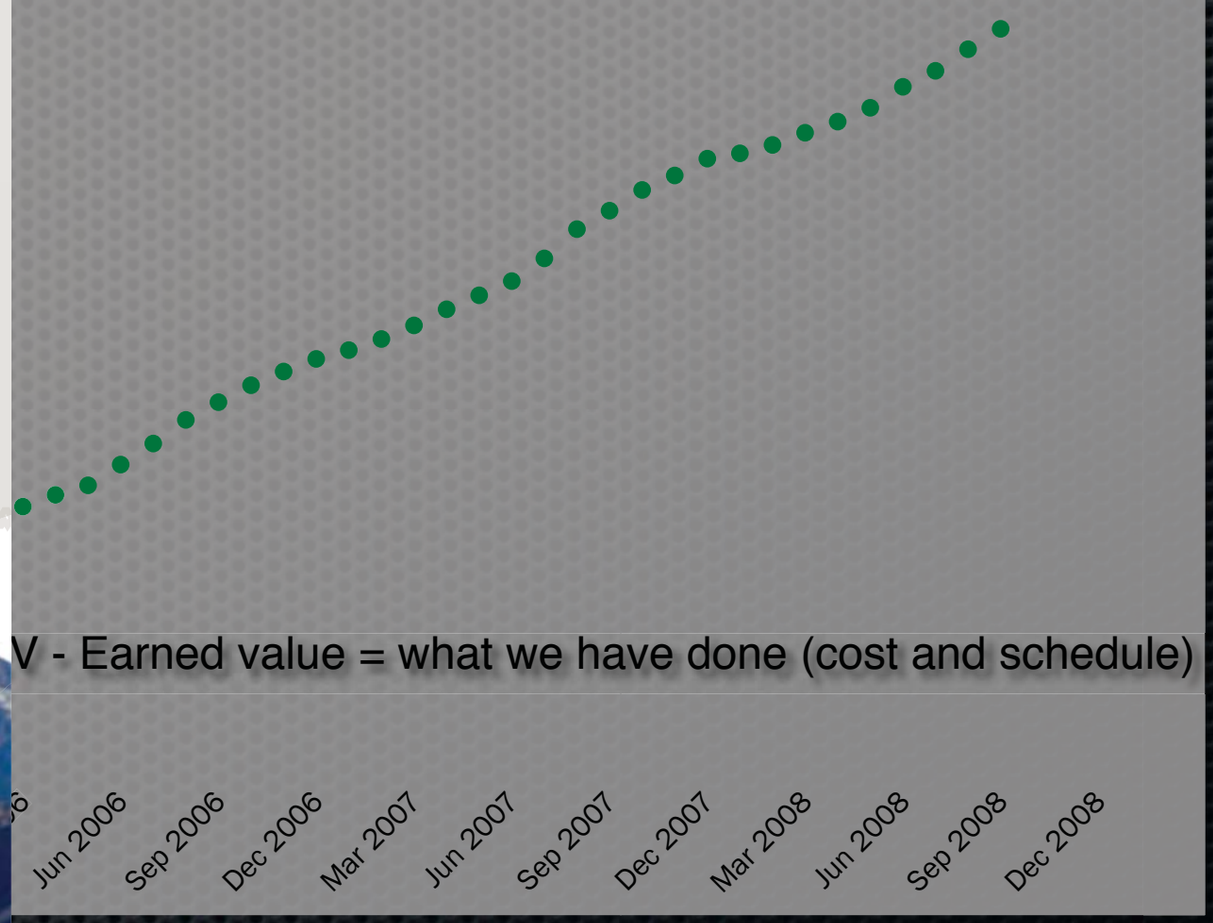
Plate Boundary Observatory

the first five years

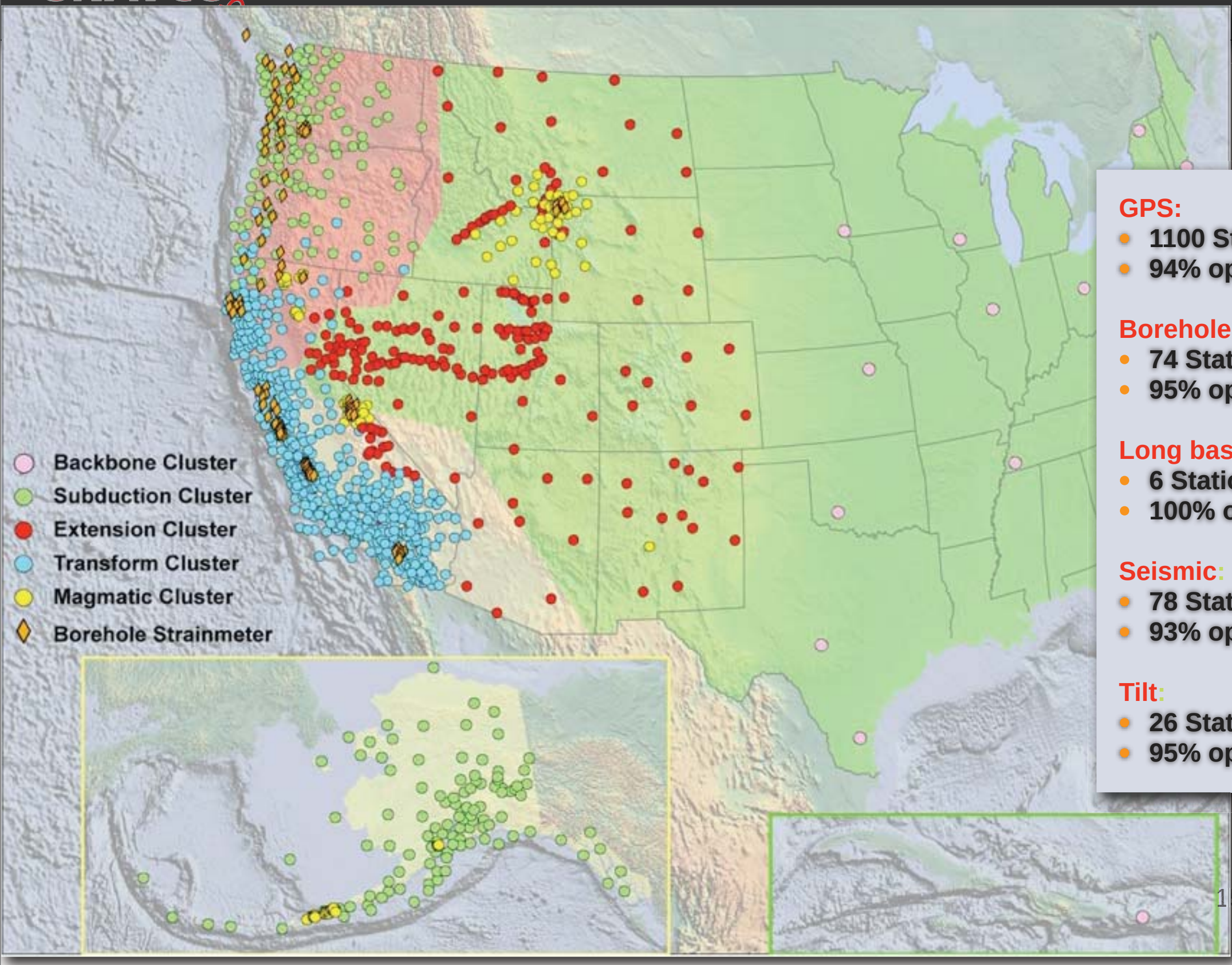
1.3 PBO



Unique Qualities of PBO MREFC and O&M

- Geographically distributed
- Strong community involvement requiring complete transparency
- Operate and maintain during construction
- Ramp up, construction, ramp down to O&M
- Unique management acknowledging difficulties in permitting, power, data communications
- Close coordination with NSF Program Managers
- Robust change control process

PBO Network Status



GPS:
- 1100 Stations
- 94% operational

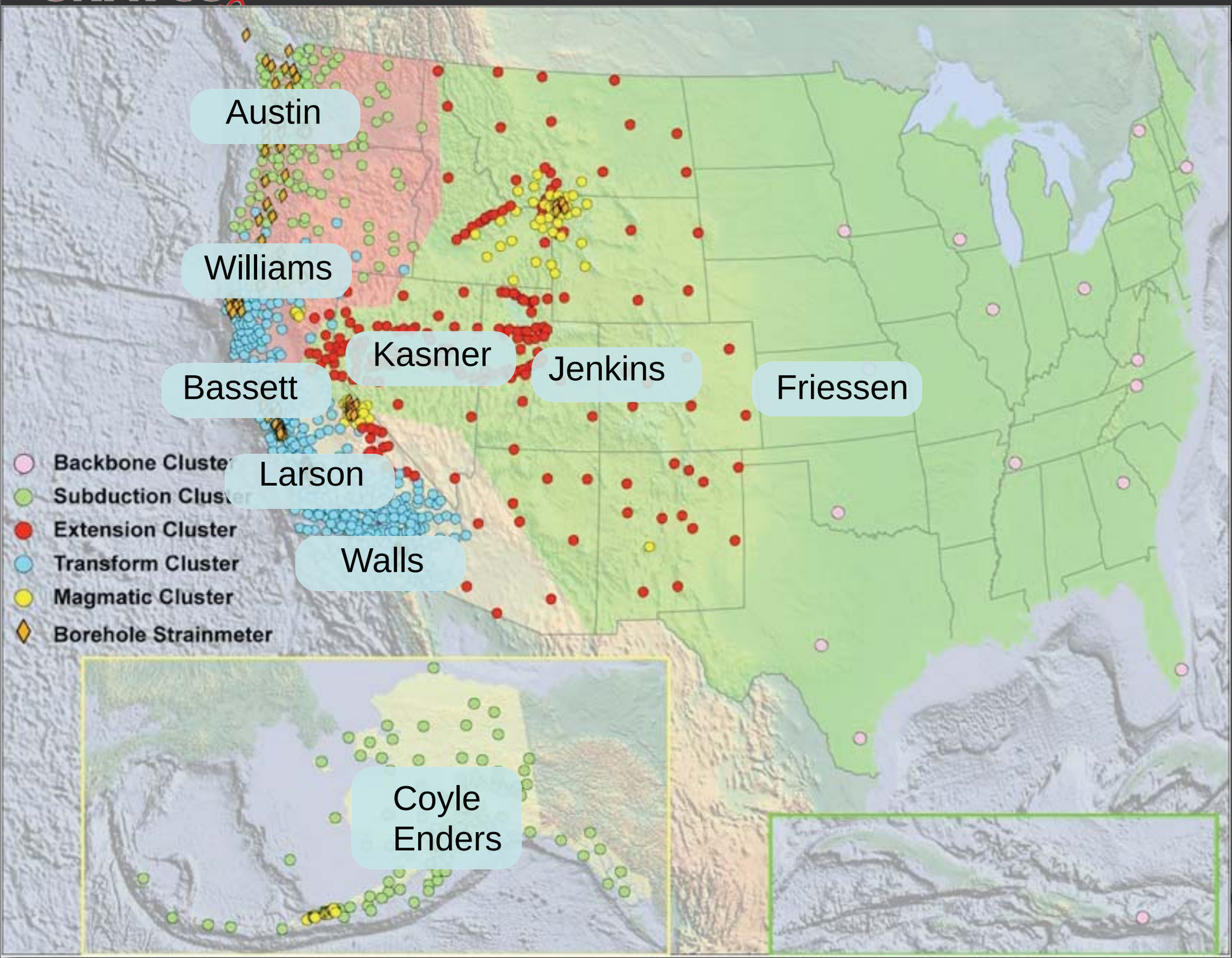
Borehole strain:
- 74 Stations
- 95% operational

Long baseline strain:
- 6 Stations
- 100% operational

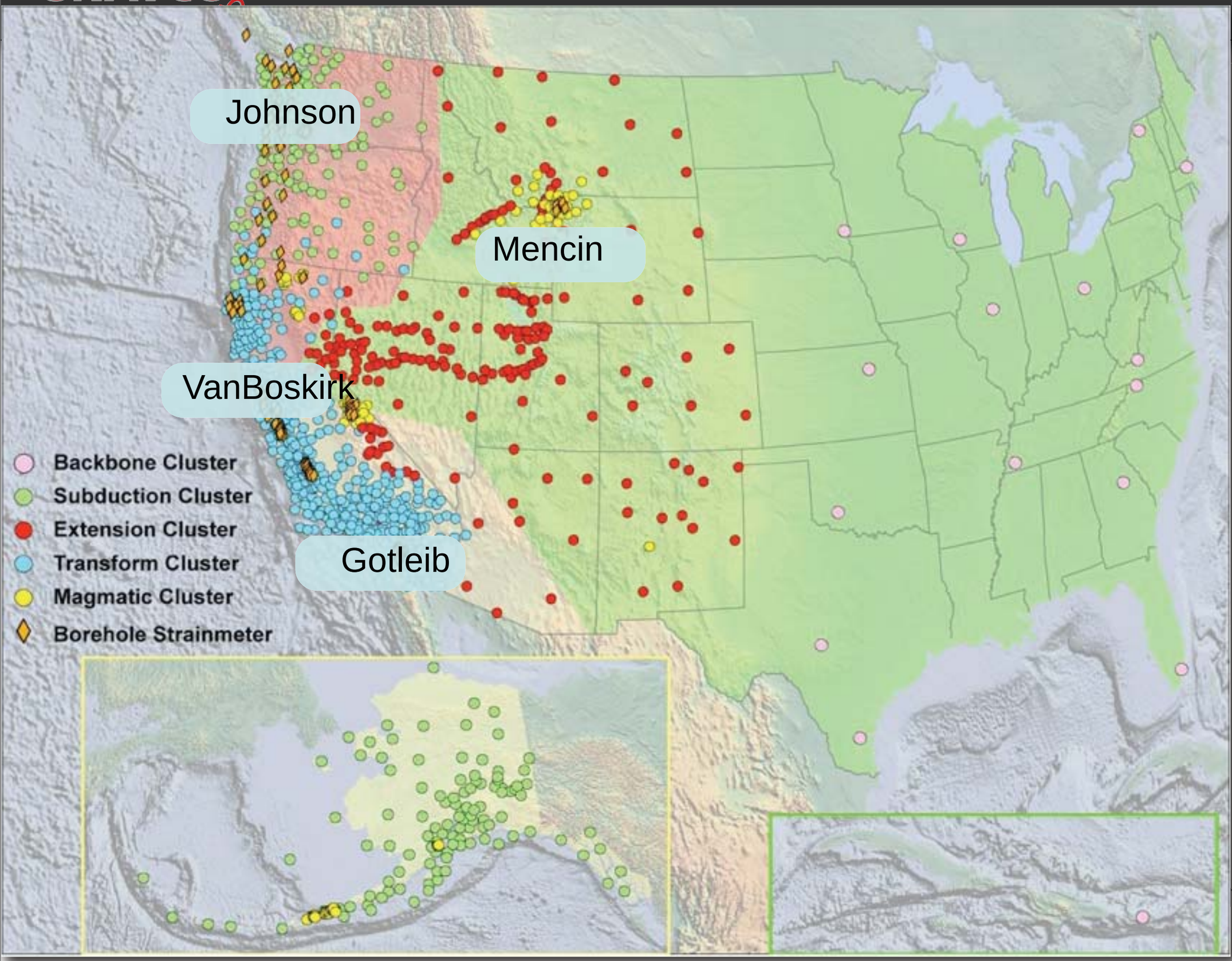
Seismic:
- 78 Stations
- 93% operational

Tilt:
- 26 Stations
- 95% operational

PBO GPS O&M Resources

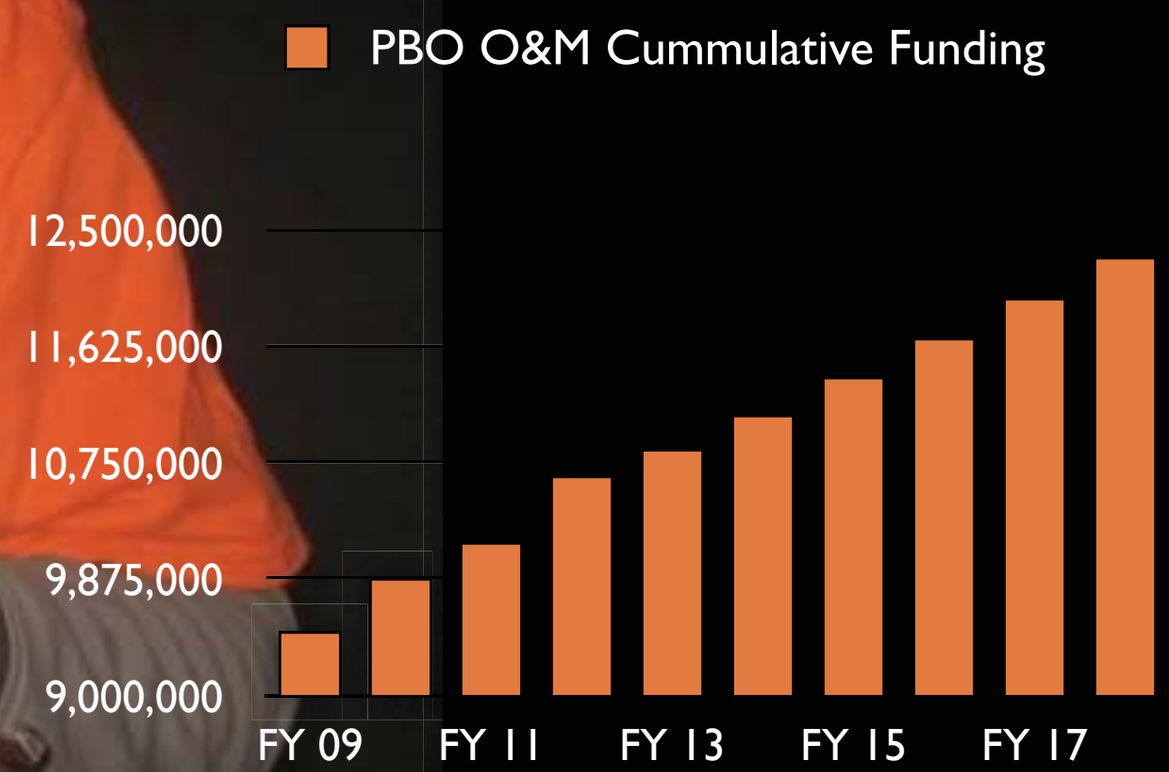


PBO Strainmeter O&M Resources



PBO O&M Funding

- $9.4M/yr. through EarthScope R&RA
- Very lean budgets
- Flexible O&M model including routine and unplanned maintenance



Operations and Maintenance

Operations and Maintenance

Operations and Maintenance


B027


P708


AV03


P708

Operations and Maintenance

Problem

Solution

Transition to Operations and Maintenance

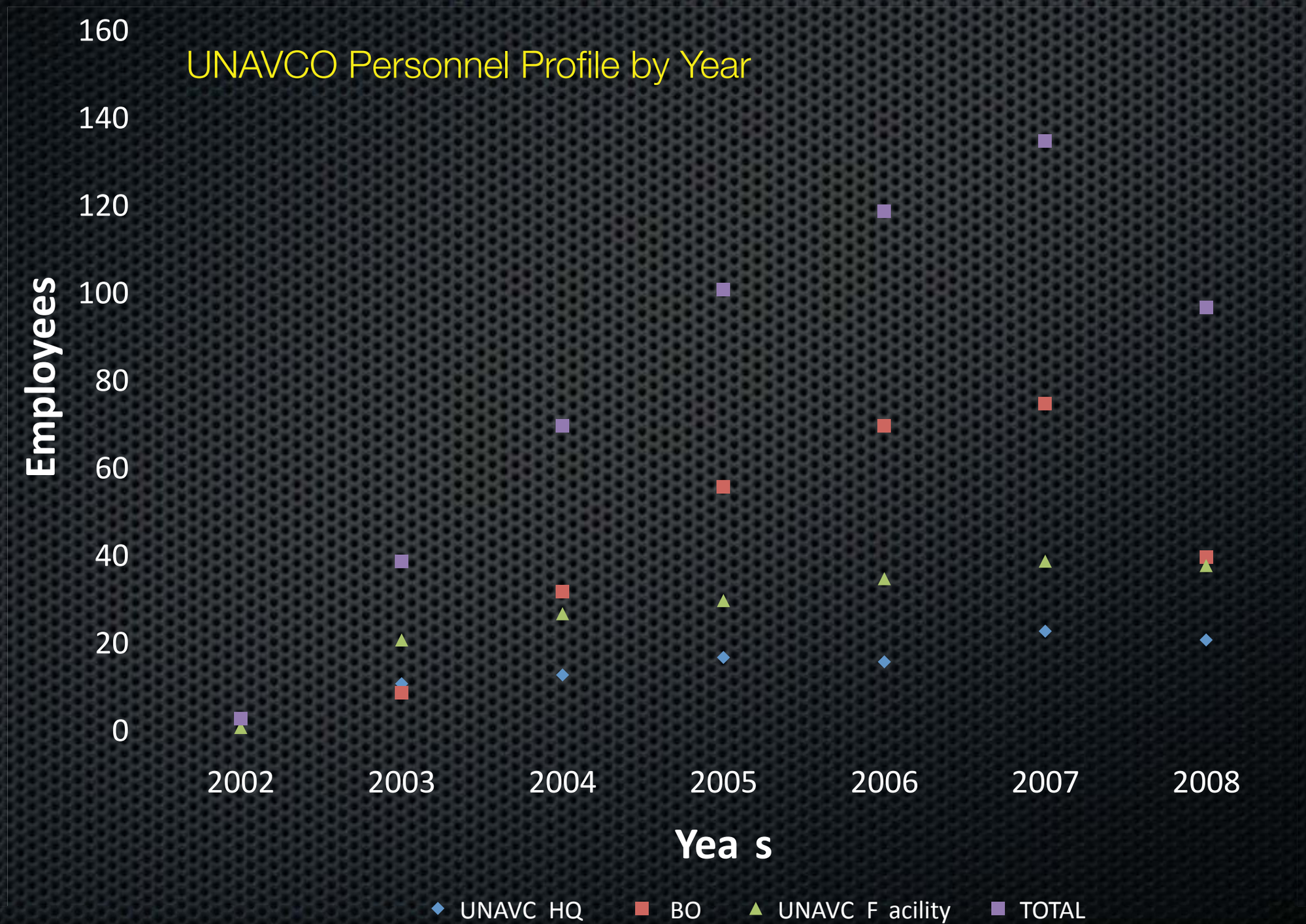
Challenges

Construction and Operations and Maintenance are uniquely different jobs often requiring very different skill sets, personalities, and management styles

Transition to Operations and Maintenance

Organizational personnel ramp-up/down can be difficult

challenges



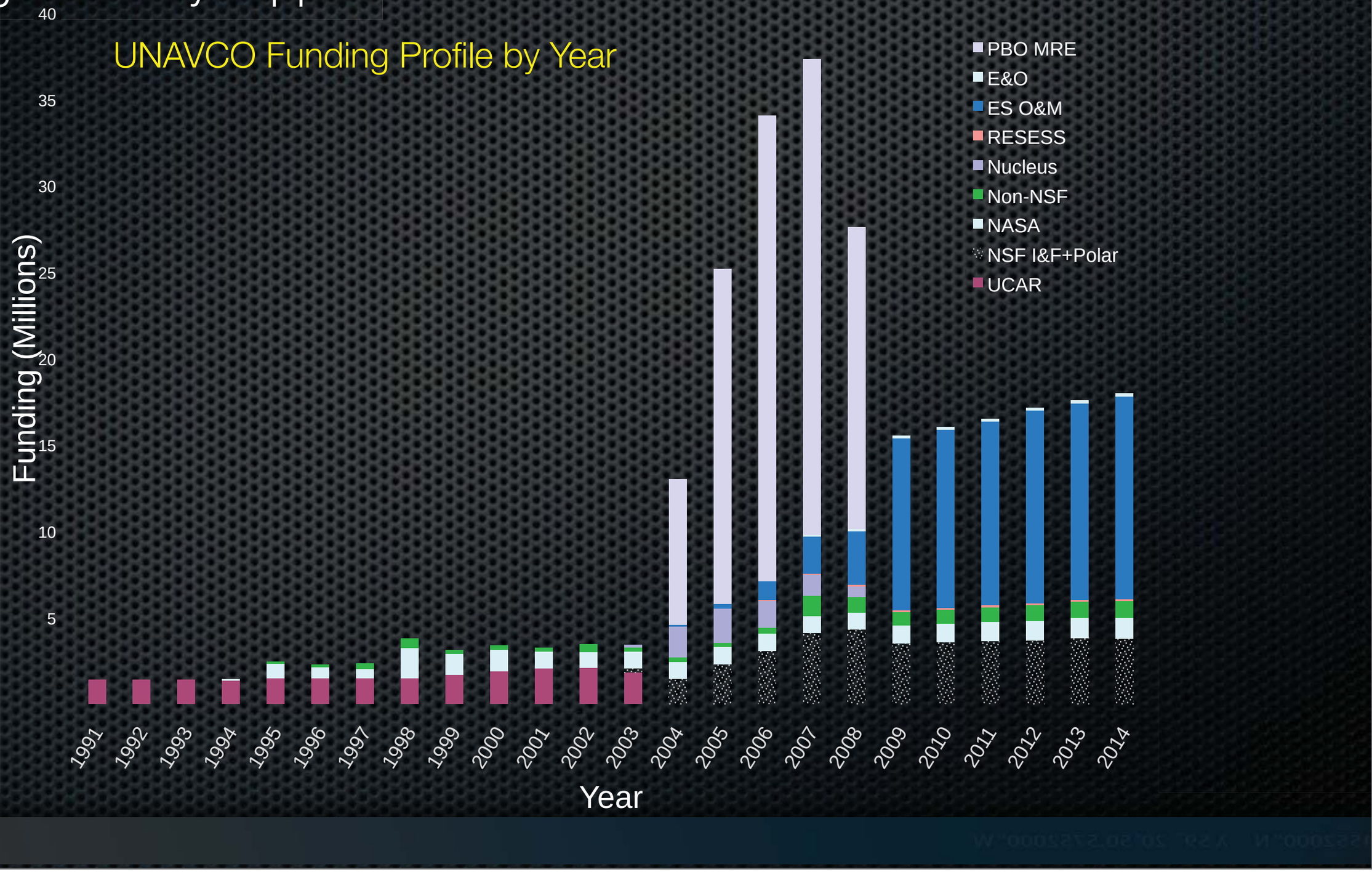
Staff Reduction

- Outgrowth of early decision to hire staff for construction rather than outsource to contractors.
- Needed full staff working right up to project completion (October 2008) but needed to reduce staff by half transitioning to O&M.
-
  - Standard UNAVCO severance allowance (one week pay per year service up to 8 weeks).
  - Retention incentive bonus where bonus starts 3-months before end of project and increased towards end of project. Incentive based on % of annual salary.
  - Outplacement and career transitioning services.
- No employees lost in the last 6-months of the project.
- Total RIF cost ~300k

Transition to Operations and Maintenance

Challenges

Funding ramp-up/down can be difficult. O&M funding comes from R&RA so Facilities are placed in direct competition with the investigators they support



Transition to Operations and Maintenance

Benefits

Staff have a more regular schedule allowing them to pursue other interests

Pre- and Post-PBO Baby Boom

Benefits

Closing Comments

- We feel we have met and exceeded NSF and the UNAVCO and EarthScope communities expectations in the construction of the PBO.
- We held to a system of strict accountability and transparency to community and sponsors.
- We completed the project on time and on budget.
- We had no serious injuries while constructing the facility.
- We all grew as managers and employees.
- We had fun.
- We meet and exceeded all PBO science goals

People Build Facilities

The construction of the EarthScope is a great success by any measure. What does not get measured, and is too often overlooked, are the amazing folks who actually planned, developed, constructed, and now operate the EarthScope facilities. Some of them are pictured in this report; all of them have created something truly remarkable and we salute them, thank them, and owe them decades of hard work on our part exploring the Earth via their magnificent creation - **Kaye Shedlock, NSF EarthScope Program Director**

Thanks!